

Retort-Pouch Packaging of Muscle Foods for the Armed Forces

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□ FOR THE FIRST TIME since World War II, the Armed Forces' basic combat ration is being replaced with an entirely new one. The earlier Meal, Combat, Individual (MCI)—much more commonly known as the "C" ration when it was not being called more unprintable names by millions of GIs—is composed basically of canned foods. It was developed at the beginning of World War II through the cooperative efforts of industry and the Quartermaster Food and Container Institute. Many of the canned meat items on today's grocery shelves owe their beginnings to that wartime development effort, since the variety of such items was very limited before that time. The MCI is being replaced now with the Meal, Ready-to-Eat (MRE), which is built around foods thermally processed in retort pouches.

As with any food system, the package and the food go together. With pouched foods, the pouch had to be developed and perfected first and then the foods adjusted to optimize them in this new system. As a result, the literature is concerned almost entirely with the retort pouch, and it is only recently that more attention is being paid to the contents.

HISTORY OF THE POUCH

The Armed Forces have been investigating the use of flexible materials for thermoprocessed foods since the 1950s. This work has been conducted at what is now known as the U.S. Army Natick Research and Development Laboratories in Natick, Mass. The early efforts were limited to a search for suitable materials (Keller, 1959; Rubinate, 1964; Szczeblowski, 1964). In 1968, Lampi reported that significant progress had been made and that it was technically feasible to use flexible laminated films to contain thermoprocessed foods. Szczeblowski (1971) summarized the results of the Armed Forces' work for the period 1959-70. He concluded that adequate information existed or was being

obtained to provide assurance for the use of thermoprocessed foods in flexible pouches by the Armed Forces.

One of the principal concerns throughout the entire experimental program was the reliability of the container. Since it was intended as a replacement for the can, it had to match the reliability of the can, one of the most reliable containers used for food. It was recognized early in the program that given a satisfactory pouch material, pouch reliability would depend upon proper filling, sealing, and handling. These factors are interrelated, and it was decided that the best way to establish the best operating procedures was to set up a prototype production system that could manufacture the various types of food needed in flexible pouches by the Armed Forces. This was done under contract to a consortium of companies headed by Swift & Co. and including The Pillsbury Co., Continental Can Co., Rexham (Bartelt), and FMC. This work proved that it was, indeed, possible to manufacture flexibly packaged, thermoprocessed foods with a high degree of pouch reliability and excellent product quality. Reports on the work of the consortium were given in a symposium (Fisher, 1973). The development of the retort pouch merited the Institute of Food Technologists' 1978 Food Technology Industrial Achievement Award (Mermelstein, 1978).

One of the most comprehensive dissertations on flexible packaging for thermoprocessed foods was prepared by Lampi (1977). In addition to summarizing the work up to 1977, it contains a list of 195 references.

REQUIREMENTS FOR RATIONS

What are the requirements for a good combat ration? The first

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thing to remember is that it is eaten under conditions where, although there may be dim lights, there are no exquisite table settings, no deferential waiters, and no soft music. A good combat ration is designed instead to be carried, prepared, and consumed under stress conditions, sometimes under what are probably the most severe stresses encountered by man. Therefore, operational rations must be designed with the following criteria in mind:

- The foods must fit the life-style of the U.S. citizen (an all-rice diet, for example, would not be acceptable.)
- They must lend themselves to being eaten as is, even though heating before eating would improve their acceptability.
- They must have long storage stability.
- They must be easy to carry and use, with no outside tools or equipment being necessary.
- Their weight and volume must be as small as possible, considering the heavy load carried by the combat soldier.
- Their quality must be good enough that the soldier will eat them rather than throw them away.

Basically, the MCI was a good combat ration. Of course, the soldiers complained bitterly about it, but since complaining about food is the heaven-sent right of all soldiers and a safety valve of no little importance, field complaints must be evaluated very carefully. Furthermore, any testing must be accomplished under realistic conditions with no other food sources available. What, then, are the major advantages of the new MRE over the MCI?

BENEFITS OF THE POUCH

In addition to the advantages of improved food quality, reduced weight, and improved carrying ease, pouched foods have an energy-saving advantage over the equivalent canned ration. Steffe et al. (1980) reported that such energy savings may occur in the

container manufacture and transportation (empty and full) and in food processing. They reported that in systems processing 43.3 metric tons (144,000 units) of raw spinach per 8-hr shift, the energy requirements with pouches were close to 50% of those for a new canning line. Included in these figures is energy required in transporting empty and filled containers over 1,231 km (765 miles).

Many of the components of the MRE and MCI are the same or very similar. The principal differences between the two rations are in the use of pouches to replace cans and the introduction of some freeze-dried products, such as meat patties and fruit. While the freeze-dried products add to the overall food quality and the decreased weight, it is our purpose in this article to discuss only the meat entree items.

The improved food quality in the pouches comes about because of the thin cross-section of the pouch compared with the can. This thinness allows the pouches to be processed in less time than the cans, yet obtain an equivalent sterilization. The reduced weight results from elimination of the cans. For example, cans and lids for 1,000 8-oz cans weigh 109 lb, while the equivalent pouches weigh 12 lb.

One of the most appealing features of the MRE is its carrying ease. The normal practice is for the serviceman to separate out the individual component packages of a ration and store them in whatever nooks and crannies he can find on his person among all the weaponry, ammunition, and gadgets he is carrying. The retort pouch lends itself to this, since it is flat and easily fits into uniform pockets. And the best part of it is, if one has to "hit the dirt" in a hurry, he doesn't almost break his leg on that canned spaghetti in his pants pocket. Instead, he has a nice soft cushion.

POUCH REQUIREMENTS

The Armed Forces has completed its first big procurement of 24 million meals of the MRE and is now in the process of procuring an additional 48 million. As would be expected in scaling-up any new item, a large number of problems have been encountered. It has been a real learning experience for both the contractors and the government. Most of the problems were

Table 1—MEAT ENTREES being packaged in the retort pouch in the Armed Forces' Meal, Ready-to-Eat (MRE) ration

Pumpable items	Placeable items	Extrudable items
Beef Stew	Beef Slices in Barbecue Sauce	Ham and Chicken Loaf
Diced Turkey with Gravy	Meatballs in Barbecue Sauce	Chicken Loaf
Diced Beef with Gravy	Ham Slices	
Chicken a la King	Beef Steak	
Ground Beef with Spiced Sauce (Sloppy Joe)	Frankfurters	

with the pouch and not so much with the products; perhaps it would be better to say that the product problems were easier to solve.

Probably the most important requirement placed upon the retort pouch was that it should have a failure rate no greater than that obtained with cans. The goal in research work was no more than one potential pouch failure per 10,000 pouches off the end of the line. Our preliminary tests and our large-scale pilot work done under contract proved that this requirement could be met under production conditions. The basic key was the pouch seal, and it was in this area that some contractors had their greatest problems. Others, however, had few problems with seals. Eventually, the contractors having problems were able to overcome them. In our opinion, the key to good seals is in establishing and maintaining a viable quality control program. The importance of quality control both in this area as well as in the overall production of pouched foods cannot be overemphasized.

PRODUCT REQUIREMENTS

As with any preservation method, products must be designed specifically for the retort pouch. This does not mean that there are major differences from, say, a similar canned product, but only that the piece configuration must be designed for the pouch and the product formulated so that the process will produce the desired product quality. It is difficult to overemphasize the term "desired product quality." In the Armed Forces' specifications, we have some rather stringent product qualities dictated by our "customer," the serviceman. Organoleptic qualities are of course very important, but equally so are the nutri-

tional qualities, since the products may very well be the sole source of a serviceman's food for considerable periods. Within the basic piece configuration, a pouch entree item can be practically any quality desired.

One of the ways we classify entree items is by the method by which they are filled into the pouch. There are three classifications—pumpable, placeable, and extrudable. The first, which is self-explanatory, requires equipment which is well understood in the food industry. Ingredients may be pumped in more than one stage. Placeable products are those items, such as ham slices, which must be placed individually in the pouch, although an added sauce or gravy would be pumped. An extrudable product such as Ham and Chicken Loaf is mechanically stuffed into the pouch in a manner similar to the way sausage is stuffed into a casing. These are generalizations, of course, and the machinery used can differ widely.

The actual meat entree items we are using in the MRE are listed in Table 1. The first two items listed under Placeable are a combination of pumpable items (sauces) and placeable items (meats). There are many more, different products that could have been chosen, but these present a fair variety, are generally liked by the servicemen, and are reasonably easy to produce.

The problems found with the products during production were not difficult to solve on an individual basis. They were concerned primarily with raw material and processing parameters that resulted in product quality different from that which had been established in the development effort. As a result of the current procurement, the product and packaging specifications are being given a

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very critical review to make sure that the Armed Forces can procure products of satisfactory quality at a reasonable cost and within recognized industrial capabilities. Included in this effort is a study of the entree-item raw material, formulation, and end-product requirements.

During the course of the devel-

opment work on the pouches, many studies were made on product acceptance, storage stability, rough-handling stability, etc. The studies were made on products resulting from laboratory and pilot-plant runs. Now that products are available from large-scale production runs, formal tests are being conducted to quantify certain factors. One of the more important studies is on storage stability, since the Armed Forces

must store operational rations for long periods under sometimes harsh conditions. In addition, storage stability is very important from an economic standpoint—the rations must be rotated into the regular feeding systems while they are still acceptable, and the longer the storage time, the fewer the rations needed to be purchased in any given year. Therefore, a storage study has been started using products from two suppliers. Storage temperatures are 40, 70, 85, and 100°F. Storage time will depend upon temperature and how well the products stand up. For planning purposes, it is expected that the products will last 2 years at 100°F, 3 years at 85°F, 5 years at 70°F, and 10½ years at 40°F. The products will be evaluated at intervals during the storage time by both technical and consumer panels. Interim reports will be available at yearly intervals.

SUCCESSFUL DEVELOPMENT

The retort pouch has been successfully developed and used for packaging all types of foods. Meat products in the retort pouch have been shown to be of better quality than canned meats and are particularly advantageous for Armed Forces use in combat feeding situations. Undoubtedly, they will find wide use in the consumer market as well.

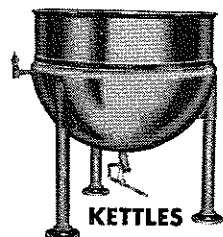
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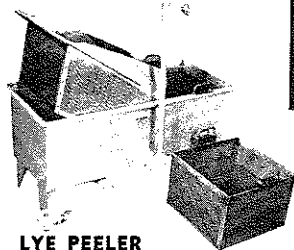
Based on a paper presented during the IFT Muscle Foods Division program, "New Processing Concepts for Muscle Foods," at the 41st Annual Meeting of the Institute of Food Technologists, Atlanta, Ga., June 7-10, 1981.

Specialized Equipment

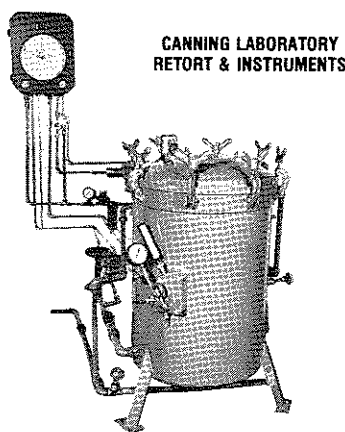
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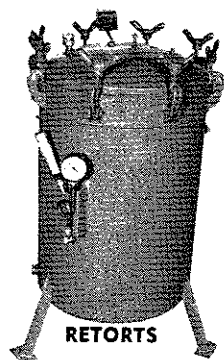
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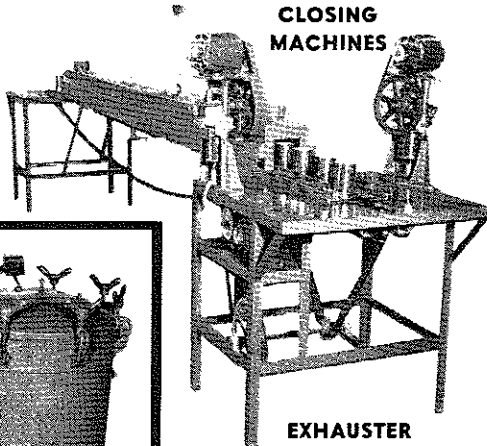
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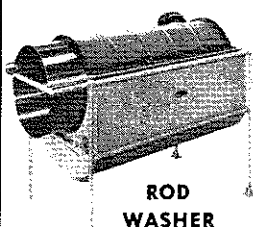
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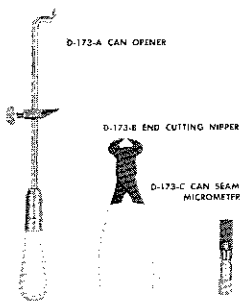
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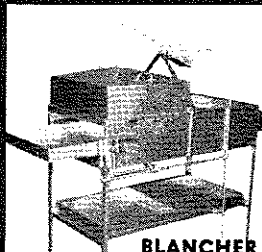


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